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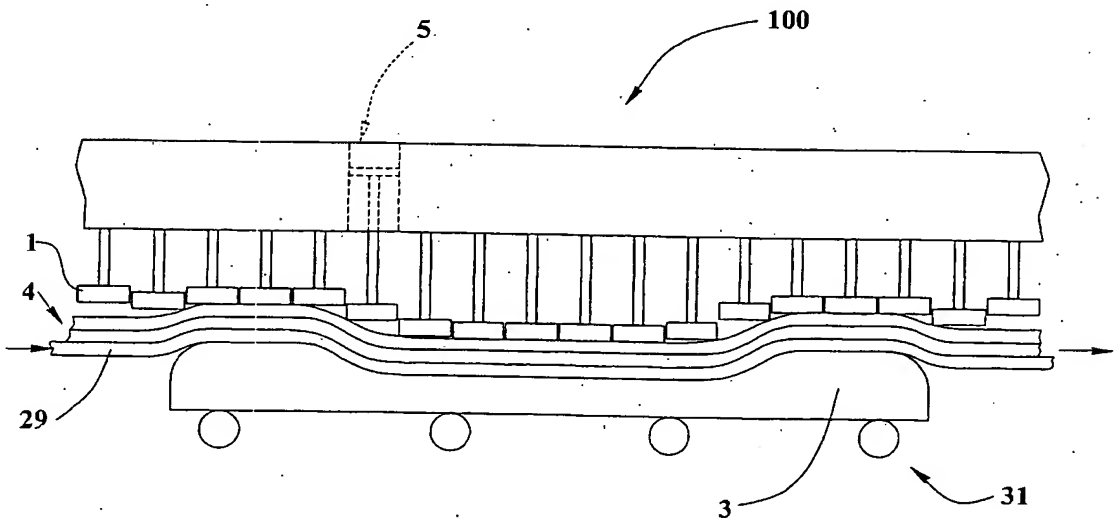
(54) Title: PRESSING DEVICE FOR SANDING MACHINE



(57) Abstract: A pressing device (100) for sanding machines includes a plurality of mobile sectors (1) allowing a sanding mean (30) to fully contact the surface of panel (3). Each mobile sector (1) is independently operated by a respective pneumatic actuator (5) between an operating condition, in correspondence of which it transmits a pressing force to the panel (3) through the sanding mean (30), and a rest condition of said sanding mean (30). The pneumatic acuator (5) is fed by at least a first source of pressured fluid (11), by means of at least a solenoid valve (12) of PWM type operated by the control means (14) fit to regulate pressing force transmitted by the mobile sector (1) in correspondence of the operating condition.

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PRESSING DEVICE FOR SANDING MACHINE

TECHNICAL FIELD

The present invention relates to sanding devices and refers to a pressing device for sanding machines fit for pressing an abrasive mean against a surface, also a complex three-dimensional surface, allowing to obtain homogeneous finishes.

BACKGROUND ART

The pressing devices, or buffers used in the known sanding machines have mobile sectors, which press the abrasive belt on the surface to be smoothed. The sectors are subjected to the same force and have a position determined by the portion profile to be sanded.

In case of complex profiles, because of the different support surfaces, some parts can be excessively smoothed and others not perfectly finished.

DISCLOSURE OF THE INVENTION

The main object of the present invention is to propose a device fit to independently operate each sector to make possible a perfect smoothing also of complex three-dimensional surfaces.

Other object is to propose a very simple and economic device fit to operate each sector in a predictive way and thus without needing feedback sensor elements.

Further object is to propose a device feedback controlled for an accurate and continuous adjustment of the force transmitted by each sector.

The pressing device object of the present invention has independent mobile sectors each one fit to exert, on the surface to be sanded, a continuously adjustable force. For this purpose each pressing sector is operated by means of a respective pneumatic actuator, in a chamber of which, or in both chambers, compressed air is introduced at periodical impulses whose unitary period and whose number are opportunely dosed (Pulse Wide Modulation or "PWM") through solenoid valves operated by a digital control programmable mean with traditional logic, or with

Fuzzy logic and in which the number and the period of the impulses, required to obtain the pressure variations, are stored.

The expected pressure, and thus the optimal force transmitted to the mobile sector, is therefore reached in a predictive way.

The device operates a constant and accurate feedback control of the pressing force, independently of external interferences such as, for instance, environmental variations and irregularity of the supply pressure of the sector actuators, by means of optional sensors suitable to close the feedback loop by communicating to the control means the real value of the reached pressure and/or force allowing a program, which is contained in said control means and which includes a feedback control algorithm, to correct possible errors in the desired values.

BRIEF DESCRIPTION OF THE DRAWINGS

The characteristics of the invention are described in the following, with particular reference to the attached drawings, in which:

- figure 1 shows a schematic front view of the device having a plurality of mobile sectors and in an operating condition.
- figure 2 shows a schematic view of an actuator of a mobile sector of figure 1 and operation and control means.
- figures from 3 to 5 show variants of the operation and control means of figure 2.

BEST MODE OF CARRYING OUT THE INVENTION

With reference to figures 1 and 2, numeral 100 indicates the pressing device for sanding machines object of the present invention.

The sanding machine, known and not shown, includes sanding mean 30, having an abrasive belt 29, rotating with closed loop around at least three rolls, whose at least one is a motor roll and at least one is a tensioning roll. The sanding mean 30 may include translation means 31 of the panel 3 to progressively sand this latter by means of the abrasive belt 29.

The device 100 is provided with a plurality of mobile sectors 1 fit to transmit pressing forces to

the sanding mean 30 to bring this latter against the surface, flat or shaped in two or three dimensions, of a panel 3 to be finished.

Between the sanding mean 30 and the mobile sectors 1 a slipping mean 4 is interposed, fit to share the pressing forces exerted by said sectors 1 and to reduce the frictions.

The slipping mean 4 includes at least a distribution layer of the pressing forces consisting of a thin continuous belt made of steel or carried out by links or articulated plaques or a linenized rubber plate, and at least an anti-friction layer made of felt or material with graphite or Teflon. The slipping mean 4 may include also further layers, for instance made of foam-rubber or elastic foam.

The slipping mean 4 may be fixed or in motion, for instance, perpendicular to the panel 3 motion.

The slipping mean 4 may further include a set of fixed layers and a set closed loop layers, moved with rotary motion.

Each mobile sector 1 is independently moved between an operating condition L and a rest condition from the sanding mean 30, by means of a respective actuator 5 consisting of a double effect pneumatic cylinder.

In the operating condition L, each sector 1 is positioned by the actuator 5 in correspondence of the sanding mean 30 and transfers on this latter a pressing force generated by the actuator 5 and fit to cause the contact, and therefore the smoothing, of the corresponding portion of the panel 3 by the sanding mean 30.

In the rest condition, each sector 1 is positioned by the actuator 5 at the maximum distance from the panel 5 to allow the insertion or the exit of said panel 5 from the sanding machine.

The actuator 5 is fed by a first source of pressured fluid 11, for instance consisting in the exit of a first pressure switch of a compressed air tank.

Each mobile sector 1 is connected to the free end of a rod 7 of a piston 6 of the relative actuator 5.

The piston 6 separates a first chamber 9 from a second chamber 8 crossed by the rod 7. The first

chamber 9 is connected 11 to the first source of gaseous fluid through respective valve means 42 operated by control means 14.

The second chamber 8 is connected to a duct directly coupled to a second source of pressured fluid 10, for instance, consisting in an exit of a second pressure switch of the compressed air tank, regulated at a pressure value lower than the first pressure switch value.

The valve means 42 include a solenoid valve 12 of PWM type operated by the control means 14 by a program that regulates in a predictive way the pressing force exerted onto the relative mobile sector 1 causing at least a number and an unitary duration of periodic opening impulses of said at least solenoid valve 12 for producing a difference of pressure between the rooms 8, 9 applying to the piston 6 a differential pressure corresponding to said pressing force.

The valve means 42 have a three-ways body and are operated by the control means 14, to set the first chamber 9 of the related actuator 5 alternatively in a closing condition, flow communication condition with the first source 11 by means of said opening impulses or connection condition with the atmospheric environment to maintain unchanged the pressure of the first chamber 9, to increase the pressure by moving the sector 1 in the operating condition and/or to increase the pressing force, to reduce the pressure.

The control means 14 consist of a programmable microprocessor controller or an industrial computer or a PLC or, preferably, a personal computer PC and they are provided with interfaces 15 for the independent operation of each valve mean 42.

The device operation provide that, starting from the rest condition in which the pressure of the second chamber 8 maintains elastically close the related sector 1 to the respective actuator 5, the control means 14 calculate the number and the unitary duration of periodical opening impulses of the PWM-type solenoid valve 12 corresponding to the pressure value requested in the first chamber 9. Consequently the solenoid valve 12 connects in flow communication intermittently the first chamber 9 with the first source 11 and the piston 6 goes down and transmits by means of the rod 7 the pressing force to the sector 1 which therefore presses the sanding mean 30 against the related portion of panel 3 exerting a pressing force with a predetermined value that can be different for each mobile sector 1.

The control means 14 operate the closing of the solenoid valve 12 to maintain constant the position and the pressing force of the sector 1 up to a variation of these latter. A predetermined

reduction or increase of said force is obtained by the control means 14 operating respective opening impulse sequences of the first chamber respectively toward the atmospheric environment and toward the first source 11.

The control means operate the return of the sector 1 in rest condition connecting the second chamber 9 in flow communication with the atmospheric environment through the valve means 42 for a predetermined total time sufficient to exhaust the pressure of this last chamber. The second chamber 8 behaves like an elastic mean that exerts on the piston 6 a force in the direction of the first chamber 9. A spring or an other equivalent mean is provided for operating as the second chamber 8.

The variant of figure 3 differs from the preferred embodiment in that the valve means 42 are of the type with two separated valve bodies each one having two ways, and for the presence of transducer mean 16 associated to each actuator for transmitting to the control means 14 data regarding the position of each sector 1.

Each transducer mean 16 consists of a potentiometer or a rotary or linear encoder, connected to the rod 7.

The operation of this variant provides, for instance, that the control means 14 operate opening impulses of the valve means 42 of each actuator 5 for introducing compressed fluid into the related first chamber 9 till said impulses cause corresponding movements of the respective sector 1. The contact of this latter with the panel 3 surface causes a reduction or interruption of said movements. In correspondence of said reduction the control means 14 determine the number and the duration of the opening impulses of the PWM solenoid valve 12 in order to transmit the predefined pressing force to the sector 1.

The detection by one of the transducer means 16 of a movement of the related sector 1 in absence of opening impulses, is considered by the control means as a thickness variation of the panel 3 with consequent adjustments of the pressing force.

In the variant of figure 4, each mobile sector 1 is associated to respective sensor means 44 connected to the control means 14 in order to provide these latter with data regarding the pressing force of the sector 1.

Each sensor mean 44 includes a pressure sensor 46 of the first chamber 9 and a pressure sensor

46 of the second chamber 8.

Furthermore, in the variant of figure 4 the second chamber 9 is fed by respective valve means 42 controlled by control means 14 and connected to the first source of pressured fluid 11.

It is provided that the valve means 42, of the type with three-way valve body, are common solenoid valves or solenoid valves for PWM opening impulse operations.

The operation of this variant provides the closing with loop of the pressing force control of each sector 1 and thus the feedback control thanks to the measure of said force executed indirectly by the pressure sensors 46 of the two chamber 8, 9.

The control means 14 include a feedback control program, for instance of proportional type, for operating the valve means 42 of the first 9 and second 8 chambers.

It is also provided that the first chamber 9 of the preferred embodiment may have a related pressure sensor 46 for a feedback correction of the pressure values of said chamber.

The variant of figure 5 differs from the variant of figure 4 in that the valve means 42 are of the type with two separated valve bodies, each having two-way, and in that each sensor mean 44 includes a load cell 45 fixed to a related actuator mean 5, for instance between the rod 7 and the sector 1.

The operation of this variant of figure 5 provides the loop closing of the pressing force control of each sector 1 and thus the feedback control thanks to the measure of said pressing force executed directly by the load cell 45.

The main advantage of the present invention is to provide a device fit to operate each sector independently to make possible a perfect smoothing also of complex three-dimensional surfaces controlling said operation in predictive way or in negative feedback.

Further advantage of the present invention is to provide a device having a simple manufacturing, low cost and high reliability.

Other advantage of the present invention is to provide a precise device and virtually operation error-free.

CLAIMS

1) Pressing device for sanding machines including a plurality of mobile sectors (1) for allowing a sanding mean (30) to fully contact the surface of a panel (3), said pressing device (100) being characterized in that each mobile sector (1) is independently moved between an operating condition (L) and a rest condition of the sanding mean (30), by means of a respective actuator (5) fed by at least a first source of pressured fluid (11) and fit to generate a pressing force transmitted to the mobile sector (1) for allowing the sanding mean (30) to contact the panel (3) in correspondence of the operating condition (L).

2) Device according to claim 1 characterized in that each mobile sector (1) is connected to an end of the related actuator (5) having at least a first chamber (9) and a second chamber (8) separated by a piston (6) provided with a rod (7) passing through the second chamber (8).

3) Device according to claim 2 characterized in that at least one of the chambers, first (9) and second (8), of each actuators (1) of pneumatic type is connected to the first source of gaseous fluid (11) through respective valve means (42) operated by control means (14).

4) Device according to claim 3 characterized in that further includes transducer means (16) associated to each actuator for transmitting to the control means (14) data regarding the position of each sector (1).

5) Device according to claim 3 characterized in that each mobile sector (1) is fixed to the rod (7) of the respective actuator (1), each first room (9) is connected to respective valve means (42) and the second chamber (8) is connected to one between a duct of direct connection to a second source of fluid (10) in pressure and related valve means (42).

6) Device according to claim 3 characterized in that each valve mean (42) consists of at least a solenoid valve (12) of PWM type operated by the control means (14) by means of a program which regulates in a predictive way the pressing force exerted to the related mobile sector (1) determining at least a number and an unitary duration of periodic opening impulses of said solenoid valve (12) for creating a pressure difference between the chambers (8, 9) applying to the piston (6) a pressure corresponding to said pressing force.

7) Device according to claim 3 characterized in that each valve means (42) is three-way type

and it is operated by the control means (14) to set the respective chamber (8, 9) of the related actuator (5) alternatively in a closing condition, or in flow communication condition with the first source (11) or in flow communication with the atmospheric environment.

8) Device according to claim 3 characterized in that the control means (14) are a programmable microprocessor controller or an industrial computer or a personal computer or a PLC, and they are provided with interfaces (15) at least for the independent operation of each valve mean (42).

9) Device according to any of the claims from 3 to 7 characterized in that each mobile sector (1) is associated to respective sensor means (44) connected to the control means (14) to provide these latter with data regarding the pressing force of the sector (1) at least for the feedback control of said force.

10) Device according to the claim 9 characterized in that each sensor mean (44) includes at least a load cell (45) fixed to a related actuator mean (5).

11) Device according to claim 9 characterized in that each sensor mean (44) includes at least a pressure sensor (46) of at least one of the chambers (8, 9).

12) Device according to claim 1 characterized in that the sanding mean (30) includes a rotating loop abrasive belt (29) and that a slipping mean (4) is interposed between said belt and the mobile sectors (1) fit for sharing pressing forces and reducing the frictions.

13) Device according to claim 12 characterized in that the slipping mean (4) includes layers made of at least steel or rubber or felt or graphite.

14) Device according to claim 12 characterized in that the sanding mean (30) includes translation means (31) of the panel (3).

15) Device according to claim 12 characterized in that the slipping mean (4) has a motion perpendicular to the motion of the panel (3).

16) Device according to claim 12 characterized in that the slipping mean (4) includes a set of fixed layers and a set of closed loop layers moved whit rotary motion.

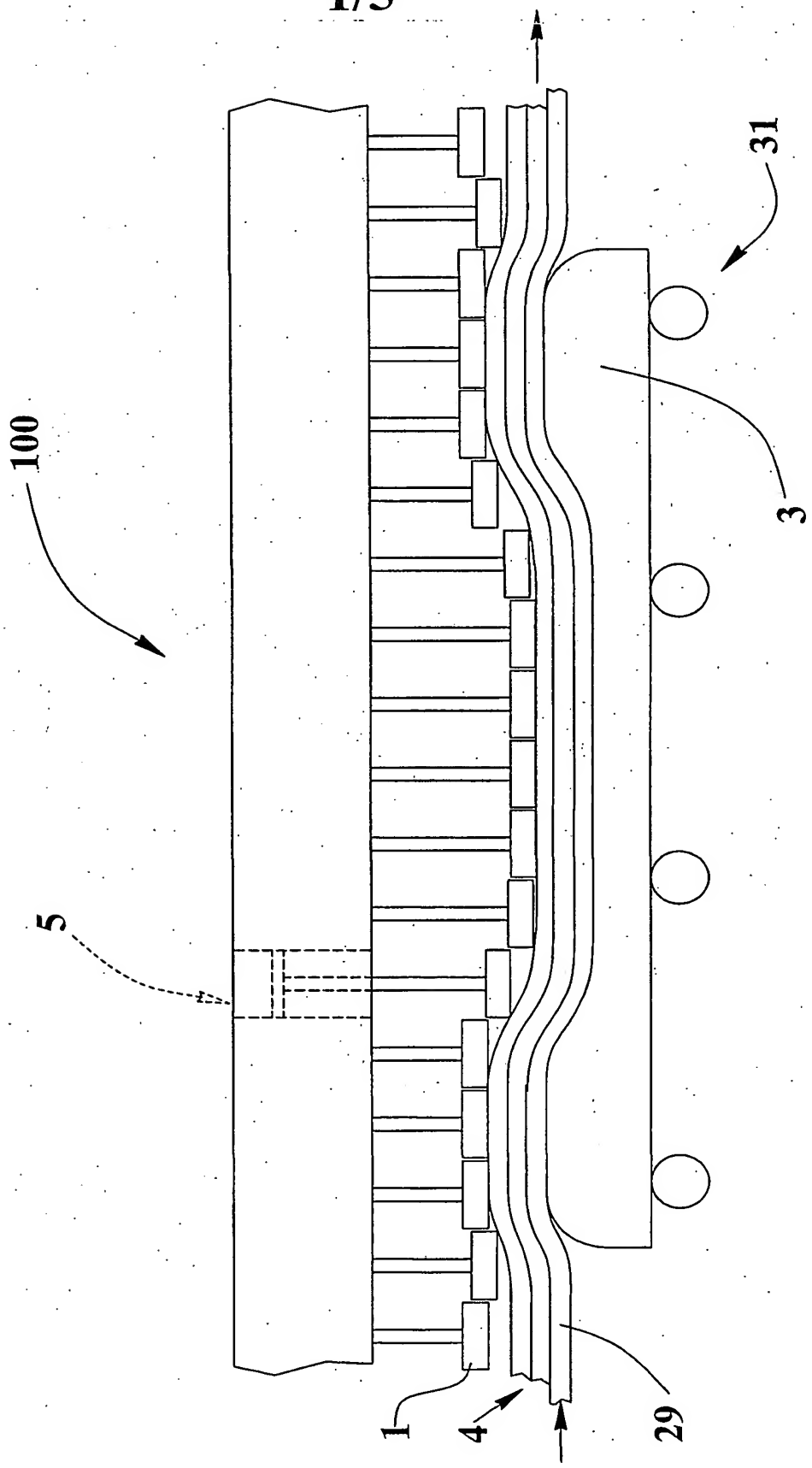


FIG.1

FIG.2

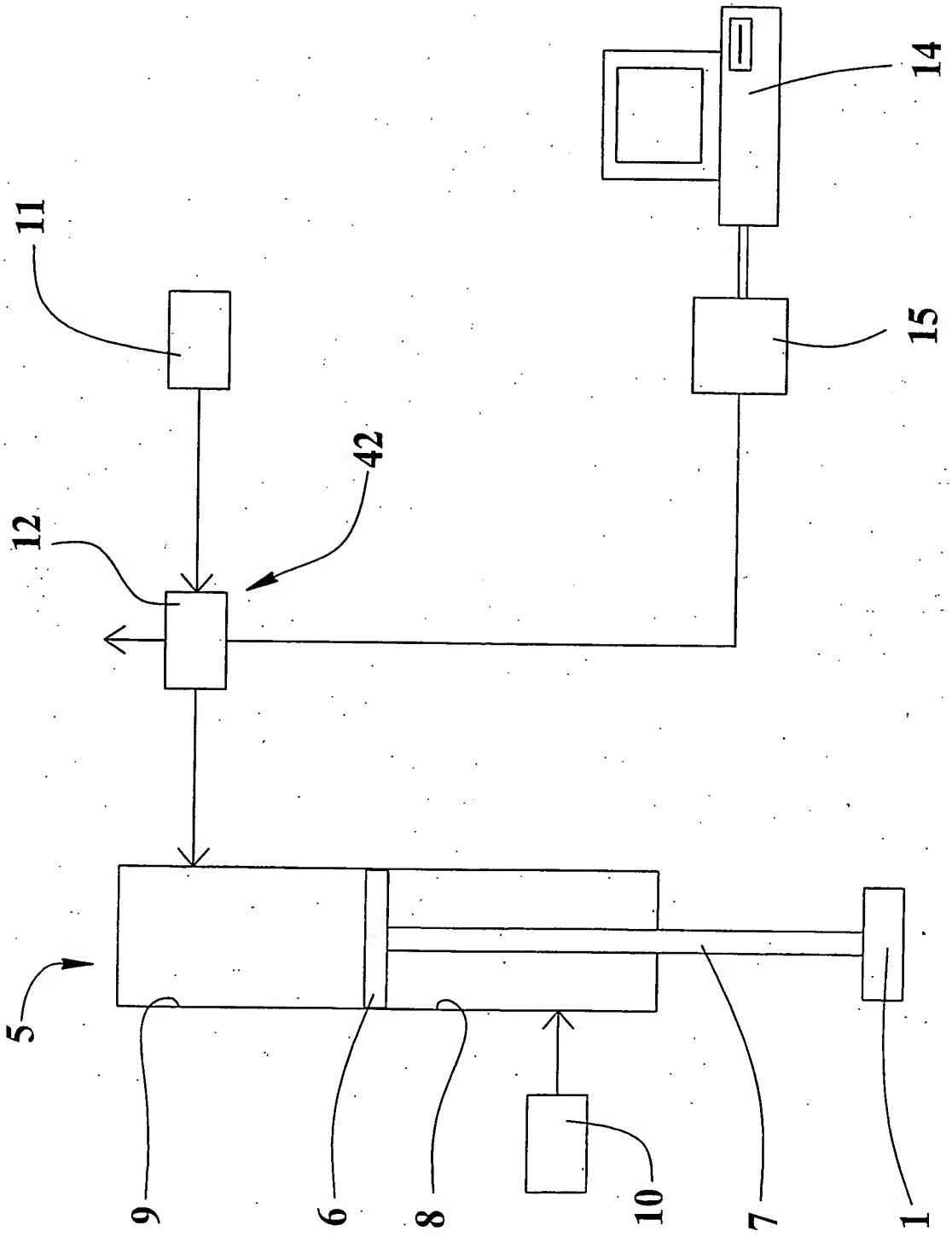


FIG.3

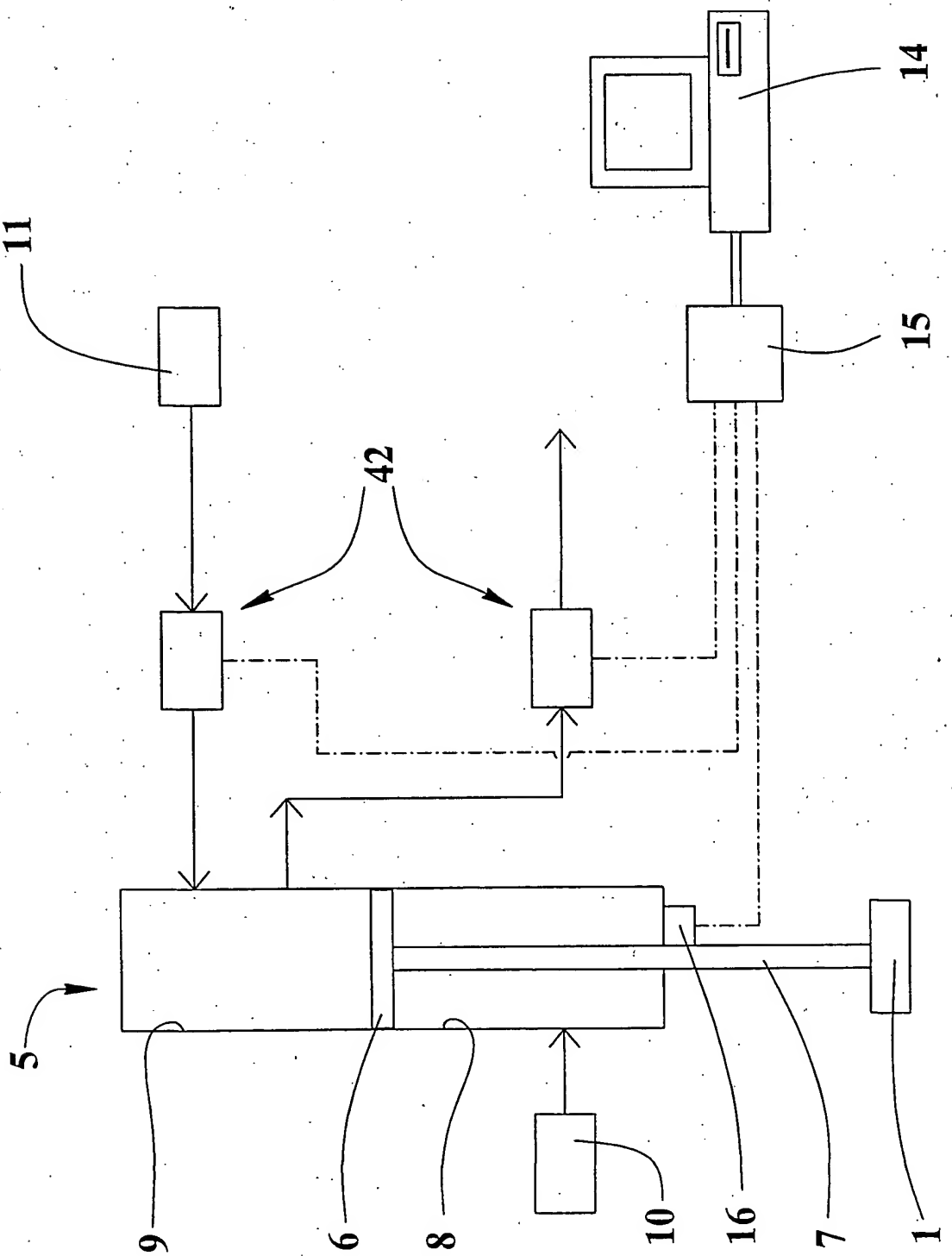


FIG.4

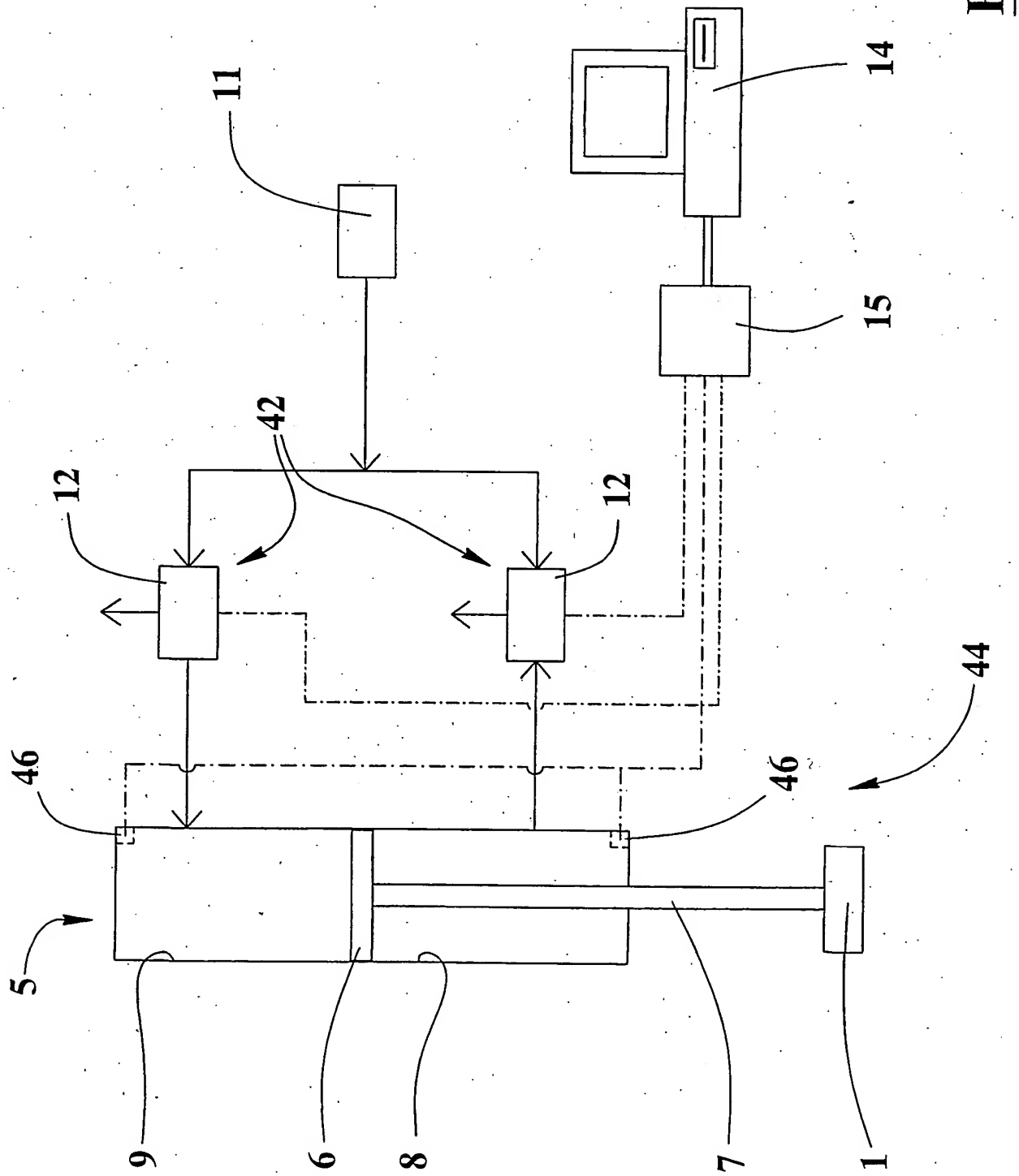
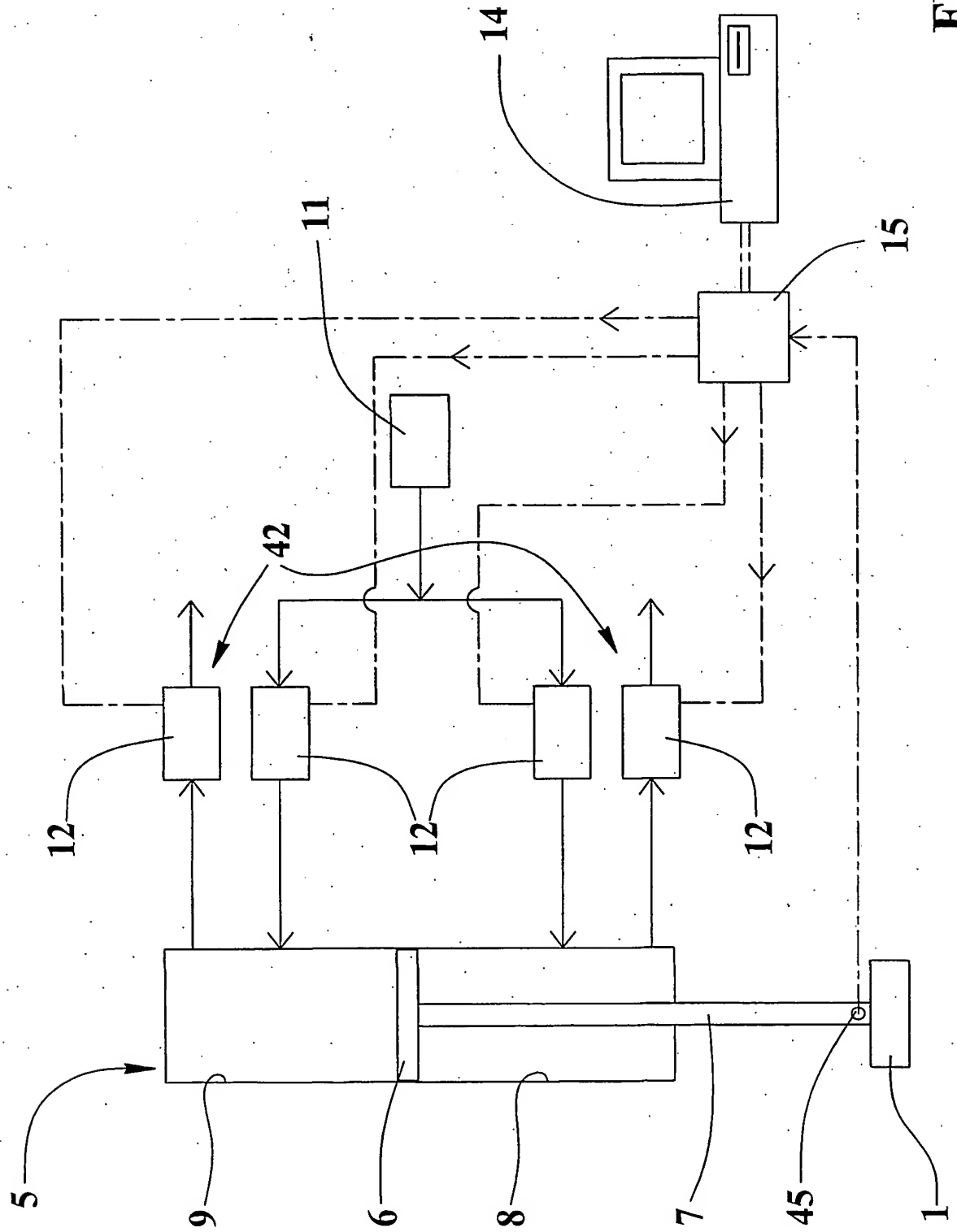


FIG.5



INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B24B21/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 3 859 757 A (HEESEMANN KARL) 14 January 1975 (1975-01-14) column 3, line 33 -column 6, line 2 figures 1,2	1-3,5, 12-16
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 January 2002	24/01/2002

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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